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This project report is concerned with the varied activities of the School Mathematics Project (SMP) for 1966-67. The activities reported on include (1) the publication program of students' texts and teachers' guides, (2) the development of texts and examinations for the Main-school course, the O-level course, and the A-level course, and (3) the overseas projects of East Africa and America. The report concludes with chapter titles of publications of SMP and notes and syllabuses regarding the content of the various examinations. (RP)

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THE SCHOOL MATHEMATICS PROJECT

DIRECTOR'S REPORT 1966/67

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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THE SCHOOL MATHEMATICS PROJECT

This, the sixth annual Report, marks a turning point in the life of the S.M.P. The original intention in 1961 was to shut up shop in about 1968, having finished the job—the job being the production of a new curriculum and texts for O- and A-level courses. The 1965/66 Report, however, explained how this intention had been overtaken by events, in particular by the wholly unexpected speed with which the " New Maths " has spread through British schools. Thus, over the last twelve months, the Project has been adapting itself to the idea of entering the new fields for research in mathematical education which are opening up as a result of the earlier work.

For this purpose it has been necessary (as was hinted at in the conclusion of the 1965/66 Report) to define what the S.M.P. is, and this has now been done by the creation, by Trust Deed, of the School Mathematics Project as a body corporate. More is said of the Trust later in this Report; here may I only say that, whatever the new management may look like, the future success of the S.M.P.'s work will depend, as it has in the past, on the abilities, enthusiasm and devotion of the author-teachers. I hope it is appreciated how much is owed to them for their efforts.

This year's Report is a little different from previous ones. No longer is it necessary to describe the motives for change or to press the claims of reformed curricula. Instead, the Report prints for the first time a list of those at present engaged in writing, editing or revising the textual material, because it is thought that detailed information about any aspect of the S.M.P.'s work can now best be obtained from individual members of this team.

But, as in past years, the various syllabuses, and the chapter titles of S.M.P. publications, are printed in full. These, while continuing to be useful for English schools, will be of special interest and relevance to the Commonwealth Conference on Mathematics in Schools due to be held in Trinidad in September 1968.

Once again, therefore, we present our benefactors, and the mathematical world at large, with an account of what we have done in the last year; we hope that it does not fall too far short of what is now being expected of us.

BRYAN THWAITES

Westfield College,
October 1967.

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1967

Further copies of this Report may be obtained from

THE S.M.P. OFFICE,
WESTFIELD COLLEGE,
HAMPSTEAD,
LONDON, N.W.3.

The Secretary of the S.M.P. is

MISS ANNE J. FREEMAN

whose address is given above, and to whom enquiries of an administrative nature may be addressed.

General enquiries of an academic nature may be addressed either to the Director at Westfield College, or to the Deputy Director, Dr. H. M. Cundy, at Marlborough College.

Enquiries about the O-Level and main-school courses or texts may be addressed to

MR. P. G. BOWIE

and enquiries about the A-Level course or texts to

DR. H. MARTYN CUNDY

both of whom are at

MARLBOROUGH COLLEGE,
MARLBOROUGH,
WILTSHIRE.

But any of those named at the back of this Report will be pleased to answer enquiries about problems of classroom presentation, the treatment of various topics or other implications of the S.M.P. course for the school curriculum as a whole.

Information about the teacher-training conferences may be obtained either from the individual organizers named in the Report or from the central co-ordinator

MISS ELIZABETH K. EVANS,
WESTFIELD COLLEGE.

The draft texts are available only from

THE UNIVERSITY BOOKSHOP,
THE UNIVERSITY,
SOUTHAMPTON,

which will provide, on request, an order form which lists all the S.M.P. publications.

The published books can be obtained through any bookshop.

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REPORT FOR THE YEAR 1966/67

The Publication Programme

The programme as it stands at present for the pupils' texts is given below.

Pupils' Book	Future Publication Date	Notes
11+ Main-school Course		1. The subsequent books of this 8-book course will follow at roughly six-monthly intervals.
Book A	June 1968	
Book B	October 1968	
11+ G.C.E. O-level Course		2. The *draft* Book 4 can be used to complete the O-level course; its contents in their final form will be spread over the published Books 4 and 5.
Book 1—published		
Book 2—published		
Book 3—published		
Book 4*	July 1968	
Book 5	April 1969	
13+ G.C.E. O-level Course		3. Although both the 11+ and 13+ courses lead to the S.M.P. O-level examination, the material in Books 3, 4 and 5 is different from that in Books T and T4.
Book T —published		
Book T4—published		
Additional Mathematics Book		
Part 1—published		
Part 2	January 1968	
Advanced Mathematics		
Book 1—published		
Book 2	January 1968	
Book 3*	July 1968	
Book 4*	December 1968	
Further Mathematics		
Book 1*	in 1969	
Book 2		

* During the year 1967/68 these books are available in draft form from the University Bookshop, Southampton.

Possibly the most noteworthy event in the programme over the last year has been the publication of the first A-level book. The material for this book has been through no less than two circulated draft stages, each of which has been thoroughly taught in a number of schools with very substantial alterations being made at each stage. This in itself is an indication of the great difficulty of composing sixth-form material which introduces major innovations. Even the text as now published by no means represents our ideal. But it seems clear to us that further improvement and further curriculum advance can only be made now after widespread experimentation with a radically new A-level course

such as the S.M.P.'s. We are confident that the S.M.P. Advanced Mathematics books will be used in large numbers of schools which will, in their turn, feed back information of great value to the second-edition stage.

The programme for the teachers' guides is as follows:—

Teachers' Guide	Publication
11+ Main-school Course	
T.G. to Book A	August 1968
T.G. to Book B	January 1969
11+ G.C.E. O-level Course	
T.G. to Book 1	published
T.G. to Book 2	published
T.G. to Book 3	published
T.G. to Book 4	September 1968
T.G. to Book 5	July 1969
13+ G.C.E. O-level Course	
T.G. to Book T	published
T.G. to Book T4	published
Additional Mathematics	
T.G. to Parts 1 and 2	February 1968
Advanced Mathematics	
A Companion to Advanced Mathematics	
Hints and Answers to Books 1 and 2	April 1968
Hints and Answers to Books 3 and 4	

Readers will be interested to note other S.M.P. publications:

1. 'Elementary Tables' are 3-figure tables designed for the main school. They are approved by all the Examining Boards for use in the examinations.
2. 'Advanced Tables' are noteworthy for the inclusion of much detail of notation, formulae and definitions. Use of these tables in the A-level examinations is also approved and indeed is strongly encouraged, since we do not wish candidates to be overburdened by rote learning.
3. 'We Built Our Own Computers' is a collection of essays by some 1964/65 sixth-formers at Exeter School; it offers many ideas for simple analogue and digital machines.
4. 'Practical Programming', to be published very shortly, is a most valuable sequel to the Exeter book. It explains the function of a programming language, and specialises in ALGOL; it draws its motivations from a number of topics in numerical analysis.

5. 'Statistics' is an extended, and in some ways a more advanced, account of the subject than is contained in the pupils' texts. This will be published in 1968 and we believe that it will be a valuable addition to the literature at the sixth-form/first-year university level.

The Main-school Course, Texts and Examinations

This development, the early stages of which were recorded in last year's Report, is of great significance. It is founded on the discovery that much of the mathematics developed for Books 1–5 and for the corresponding O-level examination is suitable for pupils in streams other than the G.C.E. streams. Indeed, we have been surprised at the number of schools with an unselected entry which have been using Book 1 in most of their first forms. The main difficulty in the use of Book 1 for all streams is the sophistication of its verbal reasoning and the occasional complexity of its mathematical argument. Thus it was felt that the retention of the main mathematical structure with a simplification of the presentation would result in a modified book which would be entirely suitable for at least the top 75% of the whole intelligence range.

The group of authors named in an appendix has already shown the utmost vigour in planning the first few books of the whole series. Its big problem at the beginning was to decide the extent to which the general sequence of topics in the G.C.E. books could or should be retained. A balance had to be struck: the greater the alterations, the greater the complication of draft texts. Certainly, we had to avoid the intense administrative problems of producing drafts on the scale on which the G.C.E. drafts were made available; on the other hand, it is essential to experiment in the classroom before committing material irrevocably to print.

The first book of the main-school course, Book A, has already gone to press and it is a pleasure to report that the Cambridge University Press will again be our publisher; we take this opportunity of thanking all the staff of the Press for the fine work they put into the production of our texts. Book A will be published in June 1968 and Book B in October 1968 so teachers may feel assured that they can start with Book A in September of that year in the knowledge that the later books will follow at regular intervals.

Probably the majority of the pupils who will be using these new books will be aiming for a C.S.E. examination. The S.M.P. does not feel that it is appropriate (as it was in the early stages of the G.C.E. course) to publish now a C.S.E. examination syllabus or specimen examination papers. However, we are very ready to help, in whatever way we can, any school which is considering the preparation of an S.M.P./C.S.E. examination; in particular, we shall have a provisional syllabus and specimen paper to offer. We are willing to discuss both with any school wishing to prepare a Mode III C.S.E. examination and also with any of the C.S.E. Regional Examination Boards.

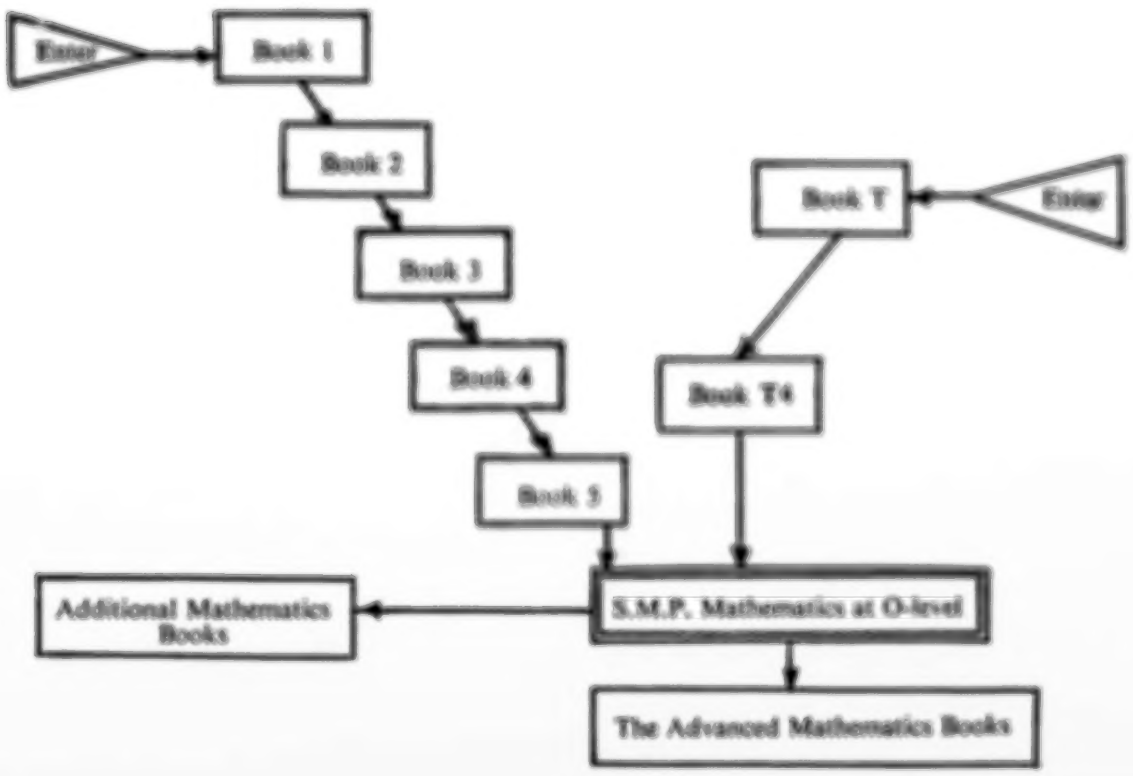
The O-level Course, Texts and Examinations

The ages of entry which have been quoted in previous years—11+ for Book 1, and 13+ for Book T—are now probably being adhered to less rigidly than in the past. For example, some preparatory schools are using Book 1 well below the age of 11+; a common

pattern seems to be to introduce it at the age of 9 and to spend nearly two years on it; Book 2 is thus started at about the age of 11, and is also regarded as nearly a two-year course. Correspondingly, one might well envisage primary schools, especially those that have been following a new curriculum such as the Nuffield Foundation's, being well placed to make use of Book 1 or Book A.

Similarly, Book T is by no means being used exclusively by public schools (which, we suspect, will tend more and more to begin with Book 3 under the prep-school influence described above). Rather it is used as a transition book in those secondary schools which, for various reasons, have their lower forms on a traditional curriculum and their upper ones on S.M.P.

It may be helpful to reproduce a diagram similar to last year's for the sequence of pupil's texts:



As for the S.M.P. Additional Mathematics Course, we stress once again that it is *not* an essential preliminary to the A-level course which is designed to follow straight on from the 'elementary' Mathematics at O-level. It offers a wide range of mathematical topics suitable for such diverse needs as those of the future mathematician (who might take it in his fifth year), of the biologists or economists (who need some post-O-level statistics) or of those who wish to spend some of their minority time on mathematics.

It is regarded as an excellent one-year course for those who wish to take their mathematics a little further but for whom the 2-year A-level may, for various reasons, be unsuitable. Equally it could also be followed with great profit by the Arts pupil for whom it could be spread over two years at, say, 2–3 periods a week. The arrangement of the topics is such that the two parts can be followed more or less independently and this introduces a welcome flexibility into the timetabling and other problems of arrangement.

It is much to be regretted that the publication of Additional Mathematics Part 2 had to be postponed until January 1968; this introduced a year's hiatus in some schools and we apologise for it. But Part 1 has been received with considerable enthusiasm and we believe that, in proposing an "Additional Maths" course which is *not* part of the main stream to A-level, we have taken a big step towards general mathematical education in the sixth form. Indeed, we could envisage this S.M.P. course having strong claims, in certain circumstances, to be (in the latest Schools Council jargon) a sixth-form "elective" subject.

Readers may be interested to judge the spread of new curricula from the following figures of O-level candidates:

Candidates for O-level S.M.P. Mathematics			
1964	1965	1966	1967
919	1,548	3,526	6,642

If this pattern of growth continues, it seems clear that the move away from the traditional mathematics is going faster than was thought feasible five years ago. In particular, there will be a surge of S.M.P. candidates in 1970 which is five years after the first appearance of the published Book 1.

As in previous years the chapter titles of the five O-level texts are printed in one of the appendices to this Report.

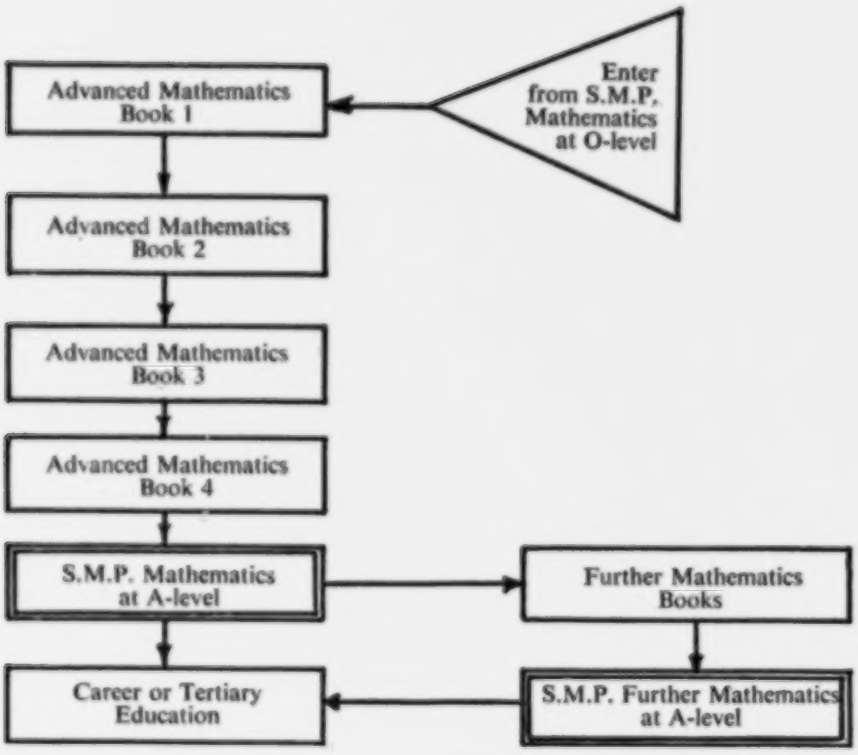
Also printed are the O-level syllabuses for Elementary and Additional Mathematics; it should be noted that these are to be thoroughly revised during 1967/68, so as to reflect more clearly the experience gained in the writing of the texts, and the revised versions will be published in next year's Report.

Finally, teachers will like to know that the collected O-level S.M.P. papers for the four examinations in 1964 and 1965 have been published in three booklets by the O. & C. Board and may be obtained from Mr. J. M. Todd, the Oxford and Cambridge Schools Examination Board, Elsfield Way, Oxford, at a price of 7/6*d.* per set of three booklets.

Teachers will also be interested to know that in the Additional Mathematics examination in 1968, the *first* paper will consist of 20 short questions, full marks being possible on 12. Paper II will be as before, 6 questions to be attempted out of 10. Thus this examination is following the pattern being adopted (from 1968) for the A-level examination in "S.M.P. Mathematics".

The A-level Course, Texts and Examinations

First, let us report again on the arrangement of the sixth-form books, as follows:


Advanced Mathematics Book 1
Enter from S.M.P. Mathematics at O-level
Advanced Mathematics Book 2
Advanced Mathematics Book 3
Advanced Mathematics Book 4
S.M.P. Mathematics at A-level
Further Mathematics Books
Career or Tertiary Education
S.M.P. Further Mathematics at A-level

The commentary on A-level which followed this diagram in the 1965/66 Report is worth recalling. It mentioned our conviction that, even at A-level, a thoroughly unified treatment of mathematics is both technically and pedagogically sound. It referred to the concept of a ' core curriculum ' for all sixth-form mathematics—an idea which seems to be increasingly favoured. And it stressed that, while the S.M.P. offers two A-level subjects, the core curriculum as manifested in the single-subject " S.M.P. Mathematics " is acceptable to nearly all universities and other institutions of higher education.

What we would like to express in addition, this year, is the frustration which is beginning to creep over those school mathematicians who wish to evolve sixth-form mathematics further away from the stage now represented by the present S.M.P. A-level texts. The general sixth-form situation is becoming rapidly more complicated and confused: the tendency for a widening ability-range at that level, a proliferation of universities and a greater variety of entrance qualifications, the effects of comprehensiveness on the character of the sixth-form (and ultimately on the first-degree courses), the national need for more highly-trained technicians and the spreading-out of tertiary education—all these influences are making it steadily more and more difficult to lay down criteria for the *content* of any one subject at the sixth-form level.

The S.M.P. is beginning to feel that the second wave of mathematical reform may be inhibited at the outset unless some means is found of cutting through this complex tissue of problems. It is particularly interested in two lines of thought which seem now to be under public discussion.

First, if A-level examinations were declared to be school-leaving examinations, then those working on new curricula would be relieved of the necessity of constantly looking ahead to the tertiary level.

Second, we note the recent suggestions from the Institute of Mathematics and its Applications that all pupils who are intending to proceed to higher education should be encouraged to study mathematics in the sixth form. This is the custom in most highly-developed countries and it is perhaps time for Britain to follow their lead. Such a move might greatly simplify the curriculum problem if it carried with it the concept of a core syllabus. Surrounding such a core would be grouped a number of minor subjects which could provide, for the many different kinds of pupils, a genuine variety of subject matter which has to be compressed in most present syllabuses within the limits of a single examination. We understand that these ideas may be studied by a joint working party between the Schools Council and the Professional Institutions most involved, in the light of the most recent Schools Council document on Sixth Form Curriculum and Examinations (S.C.C. Paper No. 63) which supersedes Working Paper No. 5.

We in the S.M.P. welcome such a study, for our work at A-level has always been directed at the concept of a core curriculum. We feel that between the Additional Mathematics syllabus at O-level, and the single-subject S.M.P. Mathematics at A-level, we have unrivalled experience of developing sixth-form mathematical material, and we shall look forward to contributing to the national developments over the next few years.

1967 saw the seventh S.M.P. O-level, and the second A-level, examination, and impressions of these examinations are now beginning to crystallise. There emerge two main points. First, it is clear that the examiners, especially at A-level, are finding it increasingly difficult to set questions which accurately match *both* the changed content in the curriculum and the changed methodology in the classroom; once one abandons the well-worn traditional paths, one finds oneself remarkably soon in uncharted territory. Second, the more deeply an examiner ponders upon the character of his examination papers, the more insistently is he faced with the fundamental question of what examinations in general are supposed to achieve.

It is interesting to recall, in this context, the Ditchley Report of last year, and its remark that the research which is being done in America on these problems of assessment far exceeds our own efforts. It is relevant, also, to point to the changing sociological climate in which examination results are likely to be regarded more as certificates of attainment than as measures of potentiality—indeed, in which a candidate is owed a pass in his examination as a a matter of human rights!

Many of these considerations must have been in the minds of the A-level examiners when, in their report on the 1967 examination, they recommended the setting up of a research team to set the 1969 examination. This recommendation has yet to be acted upon, but readers of this Report will be interested to hear that the S.M.P. regards the problem of examinations as one which requires a research effort comparable with that which has gone into the writing of the S.M.P. texts.

For 1968, the first two papers at A-level for " S.M.P. Mathematics " will be arranged in a new fashion. Paper I will consist of 27 short questions, and full marks will be obtainable on 20. Paper II will have 12 questions, with full marks on 7. This change will be made in response to a strong expression of opinion, made at the A-level conference in September 1967 by a large number of sixth-form teachers. They felt that pupils' abilities may be tested just as accurately by short questions as by long ones, and it will be possible to test this hypothesis with the new arrangement of the two papers. If the experiment supports the hypothesis, then a step will have been taken which might lead to the convenience of multiple-choice examining at A-level. Teachers will like to know, also, that the examiners' intention is for candidates to work more or less steadily through Paper I, omitting the questions they find difficult as they come to them.

University Entry

We are glad to be able to report that, with the most generous co-operation of heads of university mathematics departments and of the staff of the Committee of Vice-Chancellors and Principals, the 1967 Compendium of University Entrance Requirements contains much more accurate references to the S.M.P. A-level examinations than did the 1966 Compendium, at least in Course Table 29. The principal outcome of this exercise is that, with only one or two exceptions, all university departments of mathematics are prepared to accept, for Honours courses, candidates with the single-subject " S.M.P. Mathematics ".

Notwithstanding this, there still remain strong suspicions at least in some schools that a pupil will stand a better chance of being accepted by a university department if he has done the S.M.P. double-subject, and equally that at least some university departments are going against the spirit of their formal acceptance of the S.M.P. single-subject by requiring a graded pass in Further Mathematics on conditional offers. If there is any truth in these fears, then we greatly regret it, and we do urge universities to make it clear that the single-subject candidate is, in practice as well as in theory, at no disadvantage.

In urging this, we draw attention to the recent report of the Standing Conference on University Entrance, entitled " Review of Course Requirements for University Entrance ". In this it is recommended that no entrance requirement should include double-subject mathematics. Taken in conjunction with the Schools Council's suggestions that no pupil may take more than two A-level examinations, this strongly suggests that the days of double-mathematics are indeed numbered.

The S.M.P. Overseas

Good progress has been made in the last year with our two main overseas projects. The experimental stages of the S.M.P. of East Africa are developing well under the leadership of Mr. T. D. Morris who is now at the Curriculum Development and Research Centre in Nairobi. He leads the E.A.S.M.P. writing team consisting of :

Brother Benignus, Musoma School, Tanzania;

Mr. Colin Davis, King's College, Budo, Uganda;

Mr. John Dowsett, National Teachers' College, Kyambogo, Uganda;

Mrs. Moira Harbottle, Makerere University College, Kampala, Uganda;

Mr. David Morris (Editor), Curriculum Development and Research Centre, Nairobi, Kenya.

Mr. Gwynn Stephenson (Asst. Editor), Shimo-la-tewa School, Mombasa, Kenya;

Mr. Jim Swift, Alliance High School, Kikuyu, Kenya;

Mr. Bryan Wilson, King's College, Budo, Uganda;

Mr. David Wood, Shimo-la-tewa School, Mombasa, Kenya.

The draft Book 3 will go into the schools in January 1968 and work has started on the draft of Book 4. The demand for Book 1 has surpassed all expectations: a first printing of some 1,500 was thought to be ambitious, but already there are many thousands in use in African schools. The project continues to rely on the strong support given by the Inspectorates of the three East African territories, and the whole enterprise has been a happy collaboration between the African authorities, the Cambridge University Press and the S.M.P.

We have, nevertheless, to acknowledge that the successful carrying out of a major curriculum reform cannot be directed efficiently from a distance. For this, and other hardly less substantial reasons, the S.M.P. has decided, with regret, that its contribution to African mathematics must be limited to the four draft E.A.S.M.P. texts, and that the responsibility for the production of " final " versions must be shouldered by some other agency. It is too early for us to be able to report on what the eventual arrangements will be; but the S.M.P. is doing all it can to help and guide the present complicated discussions on the future of the E.A.S.M.P.

The first book of the U.S.A. edition will, it is hoped, soon be published. As far as we know, this is the only British " New Math " book yet published in America and we are looking forward very much to gauging the reception it has.

Other editions of S.M.P. material are being planned. There is to be a Far Eastern edition prepared by Mr. Brian Millo of St. Paul's College, Hong Kong; it is anticipated that this will be found suitable in many English-medium schools in Hong Kong, Malaysia and elsewhere. A contract has recently been entered into for an Italian translation of the English G.C.E. texts, and extensive contacts with other countries have been established.

Many members of the S.M.P. at home have given their time and energies to the furtherance of mathematics in foreign countries, and this last year has been a particularly busy one. Dr. H. M. Cundy once again led a teacher-training course in Nairobi with the help of Mr. K. Lewis, Mr. W. Mrozowski, Mr. H. Neill and Mr. J. V. Tyson. The latter three went on to a repeat performance in Kampala. Mr. M. J. Leach established some important work in Ceylon, as did Mr. K. Lewis in Mauritius. Mr. C. C. Goldsmith went to Sabah, Sarawak and Singapore; Mr. D. A. Hobbs to Malawi; and Mr. T. D. Morris to Malawi and Tanzania. Dr. B. Thwaites stirred up interest in the S.M.P. approach to school mathematics in a lecture tour of four German universities, and visited Zambia and Kenya.

The S.M.P. Trust

Last year's Report described the substantial changes which occurred about a year ago within the S.M.P. ranks and promised a further instalment in the serial story. I am very pleased to be able to report that the S.M.P. has now completed its metamorphosis, from being a university research project to a legally constituted charitable trust.

The School Mathematics Project became a Trust on 1st August 1967. The Board of Trustees numbers not more than twelve, of whom three must come one from each of the following categories: a head of a secondary school, a Fellow of the Royal Society, a Vice-Chancellor or Principal of a university or university college. The first trustees are all people who have had intimate connections with the work of the S.M.P. so far, and who will undoubtedly govern the future activities of the Project with great wisdom and imagination. They are:

Dr. H. M. Cundy
Dr. A. G. Howson
Mr. T. A. Jones
Sir Desmond Lee
Professor M. J. Lighthill
Mr. D. A. Quadling
Dr. B. Thwaites.

Teacher-training Conferences

The five conferences organised during 1966/67 showed once again what a great demand there is for training conferences orientated to a particular curriculum. They were attended by a total of some 600 teachers.

For 1968 a more extensive programme is planned in the light of the very great demand for such teacher-training conferences which are linked to a specific curriculum.

Application forms are obtainable through the detachable form at the end of this Report.

1968 S.M.P. Teacher-Training Conferences

Tuition Fee*	Place	Dates	Organizer	Topics
£15	OXFORD: Westminster College	1–5 April	D. R. SKINNER Abingdon School, Berks.	O-level Computing
£12	EXETER: St. Lukes' College	4–7 April	D. S. WIFFEN Exeter School, Devon	O-level A-level
£13	CANTERBURY: Eliott College University of Kent	8–11 April	J. A. SKINNER Maidstone Technical High School for Boys, Kent	O-level C.S.E. Computing
£12	CAMBRIDGE: Homerton College	17–20 April	A. E. LAWRANCE 149 High Street, Harston, Cambridge	O-level C.S.E.
£13	NORWICH: Keswick Hall College of Education	15–19 July	A. G. GALLANT Keswick Hall College of Education, Norwich	O-level C.S.E.
£12	NORTHUMBERLAND: Ponteland College of Education	15–19 July	J. L. LLOYD Blyth Grammar School, Tynedale Drive, Northumberland	O-level A-level C.S.E.
£15	DURHAM: Bede College	22–26 July	P. W. RUSH Bede College, Durham	O-level
£16	LONDON: Westfield College	2–6 September	Dr. B. THWAITES Westfield College, London N.W.3	A-level
£6	WEYMOUTH: College of Education	10–12 October	MRS. A. CLARK The Grammar School, Weymouth, Dorset	O-level C.S.E.

* All conferences are residential, with no additional fee for board and lodging except for the Weymouth course which is designed primarily for teachers in Dorset.

Conclusion

This Report, therefore, is the last that I shall give in my personal capacity as Director. Perhaps I may be allowed a swift backward glance over the last six years. A tremendous amount of work has been done; great changes have come about; much has been achieved. But my most vivid impression is not of the achievements but of the enormous fun it has been, and of the great enthusiasm which has been focussed so effectively.

In handing over the old S.M.P. to the trustees of the new S.M.P., my hope—and my certainty—is that the same spirit will pervade all its future activities.

MEMBERSHIP OF THE WORKING GROUPS

The following authors and principal revisers will be pleased to answer questions from other teachers, especially from those working in their own parts of the country.

Main-school course

Mr. J. K. Brunton, Redlands Training College, Bristol;
Miss J. E. Harris, Winchester County High School for Girls, Cheriton Road, Winchester;
Mr. D. A. Hobbs, Henbury School, Marissal Road, Henbury, Bristol;
Mr. K. Lewis, Rydens School, Walton-on-Thames, Surrey;
Mr. W. Mrozowski, Wandsworth School, Sutherland Grove, S.W.18;
Miss M. Whiteside, Burnley Technical High School, Towneley Holmes, Burnley, Lancs;
Miss E. M. Wilkinson, Westridge County Secondary School, Ridge Terrace, Bedlington, Northumberland.

O-level course

Mr. A. B. Bolt, St. Luke's College, Exeter;
Mr. D. A. Hobbs, Henbury School, Marissal Road, Henbury, Bristol;
Mr. D. J. Holding, S. Martin's College, Lancaster;
Mr. A. R. Tammadge, Magdalen College School, Oxford;
Mr. J. V. Tyson, Bradfield College, Bradfield, Berks.

Sixth form course

Mr. J. H. Durran, The College, Winchester;
Mr. L. E. Ellis, Marlborough College, Wilts;
Mr. G. Garrett, Shrewsbury School, Shrewsbury;
Mr. C. C. Goldsmith, Marlborough College, Wilts;
Mr. G. S. Howlett, Charterhouse, Godalming, Surrey;
Mr. T. A. Jones, The College, Winchester;
Mr. P. G. T. Lewis, Charterhouse, Godalming, Surrey;
Mr. G. Merlane, Reading School, Berks;
Mr. D. A. Quadling, Cambridge Institute of Education, Shaftesbury Road, Cambridge;
Mr. A. T. Rogerson, Charterhouse, Godalming, Surrey;
Mr. G. D. Stagg, Charterhouse, Godalming, Surrey;
Mr. J. S. T. Woolmer, The College, Winchester;
Mr. I. C. Warburton, Reading School, Reading.

CHAPTER TITLES FOR THE MAIN-SCHOOL COURSE

BOOKS A AND B

Book A

A. Prelude : Pattern
1. Number Pattern
2. Coordinates
3. Angle
4. Number Bases
5. Symmetry
6. Fractions : parts of a whole
7. Polygons
8. Other Number Patterns
9. Division
10. Polyhedra

Book B (Provisional List)

1. Tessellation
2. Decimals
3. Area
4. Comparison of Fractions
5. Angle
6. Sequences and Relations
7. Binary and Duodecimal Bases
8. Statistics
9. Multiplication of Fractions
10. Directed Number
11. Topology
12. Algebra

CHAPTER TITLES OF BOOKS 1 to 5

Book 1

1. A New Look at Arithmetic
2. Sets
3. Coordinates
4. Fractions
5. Angle
6. Number Patterns
7. Sequences and Relations
8. Polygons and Polyhedra
9. Decimal Fractions
10. Area
11. Linear Relations
12. Negative Numbers
13. Symmetry
14. Bread and Butter Arithmetic
15. Surveying

Book 2

1. Topology
2. Statistics
3. Similarity and Enlargement
4. Order and Punctuation
5. Reflection and Rotation
6. Number Patterns
7. Translations and Vectors
8. Relations and Functions
9. The Slide Rule
10. Solids
11. Ratio and Proportion
12. Trigonometry
13. Equations and Orderings
14. Pythagoras's Theorem

Book 3

1. Probability
2. Isometries
3. Matrices
4. Rates of change
5. The Circle
6. Networks
7. Three-Dimensional Geometry
8. Linear Programming
9. Waves
10. Functions and Equations
11. Identity and Inverse
12. Shearing
13. Statistics
14. Computers and Programming
15. Loci and Envelopes

Book 4

1. Matrices and Transformations
2. Solution of Equations and Orderings
3. Trigonometry
4. Logarithms
5. Isometries
6. Thinking Statistically
7. Networks
8. Searching for Functions
9. Coordinates in Three Dimensions
10. Structure and Equations
11. Rates of Change
12. Vector Geometry
13. Probability
14. Geometry: Conclusions from Data
15. Computation

Book 5 (Provisional List)

1. Areas and Graphs
2. Geometry of Sphere
3. Trigonometry
4. Quadratic Functions
5. Plans and Elevations
6. Transformations and Groups
7. Invariants
8. Statistics
9. Practical Arithmetic
10. Linear Programming

11-15. Review Chapters on: Structure, Statistics, Geometry, Computation, Matrices

CHAPTER TITLES OF ADDITIONAL MATHEMATICS BOOK
PART 1 and PART 2

Part 1

1. The Grammar of Mathematics
2. Number-systems
3. Relations
4. Polynomials and the Quadratic Function
5. Complex Numbers
6. Structure, Groups and Isomorphism
7. Logic and Boolean Algebra
8. Patterns

Part 2

9. Differentiation
10. Integration
11. Circular Measure and Circular Functions
12. Computation and Logarithms
13. Further Functions
14. Vectors and their Uses
15. Simple Dynamics
16. Further Statistics
17. Further Probability
18. Time: the Sun, Moon and Planets

THE O-LEVEL EXAMINATION IN "S.M.P. MATHEMATICS"

GENERAL

1. The emphasis of the examination will be on the understanding of simple basic mathematical concepts and their application.
2. Importance will be attached to clear expression and careful reasoning. Candidates will be expected to understand the correct use of the signs $\Rightarrow$ and $\Leftrightarrow$ and to distinguish between a statement and its converse.
3. Candidates will be expected to express physical situations in mathematical symbols and to use their judgement as to the degree of accuracy appropriate to any particular problem.
4. Slide rules with A, B, C, D scales, geometrical instruments and an approved set of tables with a list of formulae are recommended.
5. Knowledge will not be required of the rectangle properties of the circle, the angle bisector theorem, extension of Pythagoras' Theorem, secant, cosecant or cotangent functions. Where a question calls for a construction any accurate method may be adopted; but questions may be set involving the appreciation of particular methods to illustrate ideas of symmetry, or loci and their intersection.
6. Questions will not be set involving the solution of quadratic equations by formula or completion of the square.

SYLLABUS

Arithmetic problems involving the important units of weight, measure and money, including metric units. (Quantities will not be expressed in more than two units except for £. *s. d.*)

Fractions, decimals, ratio, percentage.

Numbers: prime, composite, rational and irrational; simple sequences and their generalisation.

Approximations and estimates, significant figures, decimal places, limits of accuracy.

Scales of notation other than denary. (The number a to base b will be expressed as a_b with b always in denary.)

Expression of numbers in the form $a \times 10^n$ where n is a positive or negative integer and $1 \leqslant a < 10$.

The use of the slide rule.

Length, area and volume; mensuration of common plane and solid figures; circle, sphere; parallelogram, triangle, trapezium; prism (including cylinder); pyramid (including cone).

Angle.

Graphs of sine and cosine functions; applications to simple problems.

Tangent function of acute angle. Solution of triangles by reduction to right-angled triangles, the use of Pythagoras' theorem; simple applications to three dimensional problems.

The notation and idea of a set; union, intersection, complement, subset; null and universal sets. Venn diagrams including their use in simple logical problems. Relations between the numbers of elements of sets, their unions and intersections. (Approved symbols: $\in, \cap, \cup, \notin, ', \phi, \{\ldots\}, (:), \supset, \subset, n(A)$.)

The use of symbols to represent numbers, sets, transformations and operations.

Conditional and identical equations; rearrangement of formulae, inequalities and their manipulation. The solution of simple and simultaneous linear equations and inequalities in not more than two unknowns. Solution sets in various universal sets, e.g. integers, rationals and reals.

Applications of inequalities; the use of graphs in linear programming.

Factorisation of $ax+bx$, a^2-b^2, $a^2 \pm 2ab+b^2$. The fact that $xy=0 \Longrightarrow x=0$ or $y=0$.

Simple manipulation of algebraic fractions.

Rectangular cartesian coordinates in two and three dimensions. The equation of the straight line in two dimensions and the plane in three dimensions (involving not more than two variables). Polar coordinates in two dimensions.

Informational matrices of any shape, their addition and multiplication where appropriate. Position vectors of points as 2×1 matrices. The idea of linear transformations in two dimensions and their matrix expressions; the combination, by premultiplying the position vectors by square matrices, of the transformations of reflection in the lines $x=0$, $y=0$, $x=\pm y$, and rotation through multiples of 90°. The unit matrices. The formation of the inverse of non-singular 2×2 matrices. Application of matrices to solution of simultaneous linear equations in two unknowns.

Proportion of variables related by simple power laws, $y \propto x^n$, where $n=-2, -1, 1, 2, \frac{1}{2}$, and $y \propto \sqrt{x}$. The forms of the corresponding graphs, and also of $y=ax+b$ and $y=a^x$. Knowledge of such terms as linear, inverse square, exponential.

Gradient of graphs by drawing, estimation of area under graphs, by square counting or trapezium rule (other methods may be employed but no greater accuracy is required). Applications to easy kinematics, involving distance-time and speed-time curves; the idea of rate of change.

Interior and exterior angle sums of polygons, criteria for parallelism.

The operations on Euclidean space of reflection, rotation, translation and their combinations and the operation of enlargement. The ideas of shearing and stretching.

Similarity and congruence. Symmetry with respect to reflection in lines and points, and rotation.

Applications of similarity including areas and volumes of similar figures, scales and simple map problems.

The transformations connecting directly or oppositely congruent figures.

Loci in two or three dimensions, considered as sets of points.

The circle, including the property that the angle at the centre is twice the angle at the circumference on the same arc, and tangents (but not the alternate segment property).

The ability to draw, read and understand simple plans and elevations (candidates will not be required to produce technically correct plans and elevations). Nets of solids. The angles between a straight line and a plane and between two planes.

The earth considered as a sphere; latitude and longitude, great and small circles, nautical miles, distances along parallels of latitude and along meridians.

Simple probability; problems involving the intuitive application of the sum and product laws may be set, but general statements of the laws will not be required.

Graphical representation of numerical data by bar chart, histogram, frequency polygon and cumulative frequency polygon, pie chart. Calculation of the mean (including the mean of grouped data). (The change of origin method need not be used.) Estimation of the median and quartiles. Inter-quartile range.

THE O-LEVEL EXAMINATION IN "S.M.P. ADDITIONAL MATHEMATICS"

A knowledge of the O-level syllabus will be assumed.

Algebra

The quadratic function.
Introduction to complex numbers.
Application of matrices to geometric transformations in a plane. Combination of rotations and reflections.
Linear equations in three unknowns; numerical cases only.
Elementary theory of sets. Application to probability.
Simple propositional logic. Truth-tables.
The idea of a group and isomorphism. Illustrations from permutations, geometric patterns, the number-system, residue classes to a prime modulus (finite field).

Vectors: geometry and trigonometry

Combination of translations. Vectors. Simple lattices and patterns. Displacement and position vectors.
Sum and difference of vectors. Scalar product. Components.
Sine and cosine rules.
The general angle.
Circular measure.
Addition formulae for sine and cosine.

Analysis

The idea of a function. Functional notation.
Differentiation. Linear approximation.
Time rate of change. Tangent to a graph. Turning values.
The idea of integration. Application to areas and volumes.
The fundamental theorem: $\frac{d}{dx}\int_a^x f(t)dt = f(x)$.
(Functions to be considered: simple polynomials, sine and cosine, simple cases of composite and inverse functions.)
The candidate will be expected to be able to handle, and to sketch graphs of, functions such as a^x and $1/(x-a)$ (the latter undefined for $x=a$) for real x and integral a, but where the derived function is required it will be given.

Computation

Theory of the slide rule and logarithms.
Simple iterative procedures (for example, square root and Newton's formula for equations).

Statistics

Sum and product rules for probability.

Simple distributions: small binomial (by Pascal's triangle), rectangular, triangle (throws of two dice).

Standard deviation. Cumulative frequency and percentiles.

Kendall's coefficient of rank correlation.

Mechanics

Velocity, acceleration, linear kinematics.

The application of vectors to forces and to kinematics under constant acceleration.

Simple particle dynamics including interaction of particles and the conservation of momentum.

A wide choice of questions and topics is given in the examination and full marks should be obtainable on adequate knowledge of one-half to two-thirds of the syllabus. Absolute units in the M.K.S. system, and the poundal and newton will be used.

The traditional elaboration associated with some of these topics will be foreign to the spirit of this syllabus; the absence of arithmetic and geometric progressions, fractional indices and surds, trigonometrical identities, normals, $d(uv)/dx$ and $d(u/v)/dx$, work and energy, connected particles, should be indicative of this spirit.

CHAPTER TITLES OF ADVANCED MATHEMATICS BOOKS 1, 2, 3 and 4

Book 1

1. Structure
2. Flow Diagrams, Natural Numbers and Induction
3. Number-Systems and Algebraic Forms
4. Function
5. Graphs
6. Indices and Logarithms
7. Derivatives
8. Circular Functions
9. Vectors
10. Groups

Book 2

11. Σ-Notation and Finite Series
12. Position and Spread
13. Further Vectors
14. Further Trigonometry
15. The Quadratic Function
16. Local Approximation
17. The Technique of Differentiation
18. Units and Dimensions
19. Kinematics
20. Probability
21. Linear Equations
22. Area
23. Techniques of Integration
24. Introduction to Mechanics

Book 3

25. Binomial Probability Functions and the Binomial Theorem
26. Probability Parameters
27. Introduction to Differential Equations
28. Programming
29. Exponential and Logarithmic Functions
30. Current Electricity
31. Applications of First-Order Differential Equations
32. Relative Motion
33. Momentum and Impulse
34. Complex Numbers
35. Polynomial Equations

Appendix 1—Algol
Appendix 2—Fortran

Book 4

36. Further Applications of Integration
37. Probability Density Functions
38. Samples
39. Work and Energy
40. Dimensional Analysis
41. Rational Forms
42. Linear Dependence
43. Infinity

THE A-LEVEL EXAMINATION IN "S.M.P. MATHEMATICS"

NOTES

1. What follows is the syllabus for the single-subject A-level G.C.E. examination to be entitled "S.M.P. Mathematics" by the Examination Boards.
2. The order in which the syllabus is given is not intended to be the proposed order of treatment in the texts.
3. Candidates are recommended to take to the examination either the S.M.P. Advanced Tables (published by the Cambridge University Press) which contain trigonometric and logarithmic tables, tables of standard integrals, lists of mathematical and physical formulae, definitions of algebraic structures and explanations of symbols, or similar tables. The use of slide rules will be encouraged. Artificially complicated questions will not be set.
4. Candidates will take two examination papers, set in such a way that no candidate need cover more than roughly three-quarters of the syllabus.
5. There will be one Special Paper.

SYLLABUS

Elementary trigonometry: circular functions of angles of any magnitude; the addition formulae and their consequents; circular measure.

Elementary algebra: factor theorem for polynomials; relation between roots and coefficients of algebraic equations; partial fractions (not involving more than one quadratic factor).

Coordinate systems: cartesian, plane polars.

Functions: as mappings and as graphs; range and domain. Special functions: odd, even and periodic functions. Inverse functions.

Particular functions and their graphs: algebraic; trigonometric; logarithmic and exponential, cosh and sinh.

Limits of sequences of numbers. Convergence of simple infinite series (qualitative treatment with no formal definitions or tests). Terms of a convergent sequence as successive approximations to the limit. Iterative processes.

Derivatives (of real functions of one real variable only). Differentiation of algebraic and trigonometric functions, of products and quotients, of inverse and composite functions. Second and higher derivatives. Maxima and minima; applications of differentiation to physical situations.

Tangent as a linear approximation. Approximations by the first few terms of Taylor's series; application to standard functions (for example, binomial series, circular functions). Newton's approximation to a root of an equation.

The notion of integration as summation, with applications (for example, to area, volume, mean values). Numerical methods of integration: trapezium and Simpson's rules.

The fundamental theorem of integral calculus, and its application to evaluation of integrals. Standard integrals; integration by parts; simple substitutions.

The idea of algebraic structure and of binary operations: groups, isomorphism.

Equivalence relations: equivalence classes, partitioning of sets.

Vectors. Coordinates in three dimensions. Scalar products. Lines and planes. Transformation matrices.

Systems of linear equations in 3 unknowns; geometrical interpretations and applicability of matrices.

Square matrices: echelon form; solution of 3×3 equations by reduction to echelon form. Non-square matrices (3×2 and 2×3): applications to geometrical transformations.

Vectors which vary with time: 2-dimensional applications to displacement, velocity, acceleration, relative velocity. Motion of a particle in a plane using vectors: cartesian and parametric coordinates.

Complex numbers: their sums and products. Geometric representation as (i) points, (ii) displacements, (iii) rotations and enlargements. The form $r(\cos\theta + j \sin\theta)$, the notation $|z|$, the triangle inequality.

The formation of differential equations from physical situations. Simple applications involving elementary knowledge of: Newton's laws of motion; force, momentum, impulse; conservation of momentum; work and energy; D.C. and A.C. circuit theory. (Absolute units of force only will be used. Questions may be set on other applications, in which case the questions will be self-contained requiring no prior knowledge.)

Solution of differential equations: 1st-order separable variables, linear 1st-order with constant coefficients with simple particular integrals which can be found by inspection.

The step-by-step solution of $\frac{dy}{dx} = f(x, y)$.

Computing: flow diagrams; conditional jumps.

Compound probabilities; the Binomial distribution.

Measures of spread: standard deviation. Continuous distributions. The Normal distribution (use of tables of the error function). Distribution of the mean of large samples. Tests for significance.

THE A-LEVEL EXAMINATION IN "S.M.P. FURTHER MATHEMATICS"

NOTES

1. What follows is the syllabus for the single-subject A-level G.C.E. examination to be entitled "S.M.P. Further Mathematics" by the Examination Boards.
2. The order in which the syllabus is given is not intended to be the proposed order of treatment in the texts.
3. Candidates are recommended to take to the examination either the S.M.P. Advanced tables (published by the Cambridge University Press) which contain trigonometric and logarithmic tables, tables of standard integrals, lists of mathematical and physical formulae, definitions of algebraic structures and explanations of symbols, or similar tables. The use of slide rules will be encouraged. Artificially complicated questions will not be set.
4. There will be two examination papers. No Special Paper will be set.
5. As part of a candidate's work in statistics, he may submit a short paper describing the results of some practical survey.

SYLLABUS

Elementary trigonometry: circular functions of angles of any magnitude; the addition formulae and their consequents; circular measure.

Elementary algebra: factor theorem for polynomials; relations between roots and coefficients of algebraic equations; partial fractions (not involving more than one quadratic factor).

Coordinate systems: cartesian, plane polars.

Functions: as mappings and as graphs; range and domain. Special functions: odd, even and periodic functions. Inverse functions.

Particular functions and their graphs: algebraic; trigonometric; logarithmic and exponential, cosh and sinh.

Limits of sequences of numbers. Convergence of simple infinite series (qualitative treatment with no formal definitions or tests). Terms of a convergent sequence as successive approximations to the limit. Iterative processes.

Continuity.

Derivatives (of real functions of one real variable only). Differentiation of algebraic and trigonometric functions, of products and quotients, of inverse and composite functions. Second and higher derivatives. Maxima and minima; applications of differentiation to physical situations.

Tangent as a linear approximation. Approximations by the first few terms of Taylor's series; applications to standard functions (for example, binomial series, circular functions). Newton's approximation to a root of an equation.

The notion of integration as summation, with applications (for example, to area, volume, mean values). Numerical methods of integration: trapezium and Simpson's rules: integral inequalities; applications to areas.

The fundamental theorem of integral calculus, and its application to evaluation of integrals. Standard integrals; integration by parts; simple substitutions.

The idea of algebraic structure and of binary operations: groups, rings, fields and vector spaces; isomorphism.

Equivalence relations: equivalence classes, partitioning of sets.

Simple ideas of the axiomatic development of a geometry; illustrations will be drawn from finite geometries, affine geometry and other transformation geometries.

Vectors. Coordinates in three dimensions. Scalar products. Lines and planes. Transformation matrices.

Systems of linear equations in 3 unknowns; geometrical interpretations and applicability of matrices.

Square matrices: echelon form; solution of 3×3 equations by reduction to echelon form; consistency. Non-square matrices (3×2 and 2×3): applications to geometrical transformations and to equations.

General equation of the second degree: reduction to standard forms; principal axes. Alternative derivations of conics.

Descriptive 3-dimensional geometry; the transformations, applied to 3-dimensional figures, of enlargement, reflection in planes and points, rotation and inversion.

Differential properties of plane curves.

Vector products: moments and rotation.

Vectors which vary with time: 2-dimensional applications to displacement, velocity, acceleration, relative velocity and relative acceleration. Motion of a particle in a plane using vectors: cartesian and parametric coordinates. Differentiation of variable unit vectors. The simple dynamics of particles and rigid bodies in three dimensions.

Complex numbers: their sums and products. Geometric representation as (i) points, (ii) displacements, (iii) rotations and enlargements. The form $r(\cos\theta+j\sin\theta)$, the notation $|z|$, the triangle inequality.

Roots of $z^n=1$. $e^{j\theta}=\cos\theta+j\sin\theta$.

Further geometrical properties in the complex plane including inversion and Apollonius's circle. Simple conformal transformations.

The formation of differential equations from physical situations. Simple applications involving elementary knowledge of: Newton's laws of motion; force, momentum, impulse; conservation of momentum; work and energy; D.C. and A.C. circuit theory. (Absolute units of force only will be used. Questions may be set on other applications, in which case the questions will be self-contained requiring no prior knowledge.)

Solution of differential equations and sketching solution curves: 1st-order separable variables, linear 1st-order and 2nd-order with constant coefficients with simple particular integrals which can be found by inspection.

The step-by-step solution of $\frac{dy}{dx}=f(x, y)$.

Computing: flow diagrams; conditional jumps; modification.

Compound probabilities. Markov chains. The Binomial and Poisson distributions.

Measures of spread: standard deviation. Continuous distributions. The Normal distribution (use of tables of the error function). Distribution of the mean of large samples. Tests for significance. 2×2 contingency tables.

1968 Teaching Conferences

Inclusive Dates	*Place*	*Courses*	*Tuition Fee*
April 1st–5th	Oxford: Westminster College	O-level Computer Course	£15
April 4th–7th	Exeter: St. Luke's College	O-level A-level	£12
April 8th–11th	Canterbury: Eliot College, University of Kent	O-level C.S.E. Computer Course	£13
April 17th–20th	Cambridge: Homerton College	O-level C.S.E.	£12
July 15th–19th	Norwich: Keswick Hall College of Education	O-level C.S.E.	£13
July 15th–19th	Northumberland: College of Education, Ponteland	O-level A-level C.S.E.	£12
July 22nd–26th	Durham: Bede College, University of Durham	O-level	£15
September 2nd–6th	London: Westfield College	A-level	£16
•October 10th–12th	Weymouth: College of Education	O-level C.S.E.	£6

All the courses are residential and there is no additional charge for residence.

•This course is primarily intended for Dorset teachers and is therefore non-residential. Accommodation, however, is readily available in Weymouth and the conference organiser is willing to help with finding this.

Forms of application can be obtained from The Secretary, S.M.P. Office, Westfield College, Hampstead, London, N.W.3, by returning the detachable slip below.

– – – – – – – – – – – – – CUT ALONG DOTTED LINE – – – – – – – – – – – – –

To: The Secretary, S.M.P. Office, Westfield College, Hampstead, N.W.3.
Please send me application forms as follows:—

.....copies for Oxford Conference

.....copies for Exeter Conference

.....copies for Canterbury Conference

.....copies for Cambridge Conference

.....copies for Norwich Conference

.....copies for Northumberland Conference

.....copies for Durham Conference

.....copies for London Conference

.....copies for Weymouth Conference

BLOCK LETTERS PLEASE

Name: .....

Address: .....

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N.B. A stamped addressed foolscap envelope, for the return of the forms, would be much appreciated.